

## Fungi on Submerged Wood in a Small Stream on Mt Lewis, North Queensland, Australia

Kevin D. Hyde and Teik-Khiang Goh

Department of Ecology and Biodiversity, The University of Hong Kong, Pokfulam Road, Hong Kong.

### Abstract

Results of an investigation into the fungi associated with submerged wood in a small stream on Mt Lewis, North Queensland, Australia is reported. Forty-two fungi were identified including 20 ascomycetes and 22 deuteromycetes. The frequency of occurrence of these fungi is discussed in this paper. A new species, *Didymostilbe australiensis*, and some other notable species, are described and illustrated.

### Introduction

We are investigating the fungi causing the decay of wood in streams and rivers in the subtropics and tropics and have discovered a number of interesting microfungi (Goh 1997; Goh and Hyde 1996a; Hyde *et al.* 1996; Ho *et al.* 1997). These fungi are mainly ascomycetes (Hyde *et al.* 1996) and hyphomycetes (Goh 1996). In this study 100 submerged wood samples were collected from a small stream on Mt Lewis in north Queensland and examined for the presence of lignicolous fungi. This paper presents the first report of our continuing studies of freshwater microfungi from Australia. A species list, which also includes data on the frequency of occurrence of the fungi, is presented (Table 1) and discussed. Recent illustrations and the herbarium numbers are also provided here. Notes and illustrations of selected species, including one new species of *Didymostilbe*, are then given.

### Materials and Methods

One hundred submerged wood samples were collected from a 100 m section of a small, unnamed stream on Mt Lewis in north Queensland and placed in plastic bags. They were returned to the laboratory in Hong Kong within 2 days where they were incubated collectively in plastic boxes on moist tissue paper at room temperature under normal light conditions. The samples were periodically examined over the next 21 days and any fungi present were identified and where possible isolated. The material was then air dried and is held in HKU and/or BRIP. In all cases the collection details are Australia, north Queensland, Mt Lewis, on wood submerged in a small stream, June 1995, Tamsin M. and Kevin D. Hyde. The HKU (M) herbarium number is provided in Table 1. Some duplicates and the type material of the new species are also lodged at BRIP. The cultures are held in the Hong Kong University Culture Collection (HKUCC).

Table 1. Frequency of occurrence of fungi on submerged wood samples in a small stream on Mt Lewis Organised in ascending order of frequency and then alphabetically by groups.

Species	Frequency of occurrence %	Herb. No.	New to Australia	Illustrations
<i>Verticillium</i> sp.	8	2279, 2293	*	
<i>Helicomyces roseus</i> Link	6	2243	*	This paper
<i>Jahnula bipolaris</i> (K.D. Hyde) K.D. Hyde	6	2260, 2296		Hyde 1992a, Hyde and Wong 1997
<i>Massarina bipolaris</i> K.D. Hyde	5	2266, 2295		Hyde 1995
<i>Clohesia corticola</i> K.D. Hyde	4	2245		Hyde 1995
<i>Savoryella lignicola</i> E.B.G. Jones & R.A. Eaton	4	2992		Hyde 1995
<i>Annulatascus</i> sp. 3.	3	2293	*	Ho <i>et al.</i> 1997
<i>Dactylaria</i> sp. 1	3	2235	*	
<i>Dactylaria</i> sp.	3	2251	*	
<i>Didymosphaeria</i> sp.	3	2231	*	
<i>Massarina australiensis</i> K.D. Hyde	3	2278, 2294		Hyde 1992a; Hyde and Aptroot 1997
<i>Monotosporella setosa</i> var. <i>macrospora</i> S. Hughes	3	2279	*	This paper
<i>Ascomycete</i> sp. 2	3	2255, 2276	*	
<i>Anthostomella</i> sp.	2	2265, 2294	*	
<i>Candelabrum brocchiatum</i> Tubaki	2	2262	*	Tubaki 1975
<i>Lasiosphaeria</i> sp.	2	2226	*	
<i>Massarina thalassiensis</i> K.D. Hyde & Aptroot	2	2266, 2276		Hyde and Aptroot 1997
<i>Sporochisma saccardoi</i> E.W. Mason & S. Hughes	2	2314	*	
<i>Tricladium indicum</i> Sati & N. Tiwari	2	2311	*	Sati and Tiwari 1992
<i>Xylomyces chlamydosporis</i> Goos, R.D. Brooks & Lamore	2	3188	*	Goos <i>et al.</i> 1977
<i>Annulatascus velatispora</i> K.D. Hyde	1	2225		Hyde 1992b
<i>Annulatascus</i> sp. 1.	1	2274	*	
<i>Annulatascus</i> sp. 2.	1	2233	*	
<i>Aquaphila albicans</i> Goh, K.D. Hyde & W.H. Ho	1	2349	*	Goh, Hyde & Ho 1997
<i>Ascoitaiania palmicola</i> K.D. Hyde	1	2285	*	Hyde 1996
<i>Iodosphaeria aquatica</i> K.D. Hyde	1	2308	*	Hyde 1995
<i>Brachydesmiella anthostomelloidea</i> Goh & K.D. Hyde	1	2293		Goh and Hyde 1996a
<i>Cancellidium applanatum</i> Tubaki	1	BRIP 23200		Tubaki 1975; Goh and Hyde 1996b

Table 1. Continued

Species	Frequency of occurrence %	Herb. No.	New to Australia	Illustrations
<i>Cryptophiale multiseptata</i> Goh & K.D. Hyde	1	BRIP 23150		Goh and Hyde 1996c
<i>Dactylaria</i> sp. 2	1	2249	*	
<i>Dichochaeta subfuscospora</i> Kuthub. & Nawawi	1	3188	*	This paper
<i>Dictyochoeta</i> sp.	1	3188	*	
<i>Didymostilbe australiensis</i> Goh & K.D. Hyde	1	BRIP	*	This paper
<i>Exserticlava vasiformis</i> (Matsush.) S. Hughes	1	2232	*	This paper
<i>Helicoon gigantisporum</i> Goh & K.D. Hyde	1	BRIP 23200		Goh and Hyde 1996d
<i>Kionochaeta</i> sp.	1	2308	*	
<i>Massarina peeralia</i> K.D. Hyde & Aptroot	1	2234		Hyde and Aptroot 1997
<i>Massarina</i> sp.	1	2273	*	Conway and Barr 1977, Hyde 1992c
<i>Ophioceras dolichostomum</i> (Berk. & M.A. Curtis) Sacc.	1	2271		Goh and Hyde 1996e
<i>Spadicoides cordanoides</i> Goh & K.D. Hyde	1	BRIP 23201		
<i>Verticicladiella</i> sp.	1	2264	*	
<i>Ascomycete</i> sp. 1	1	2244	*	

Frequency of occurrence is calculated by the following formula:

$$\frac{\text{Number of samples species occurred on}}{\text{Number of samples examined}} \times 100$$

### Notes on Selected Species

#### ASCOMYCOTINA

##### *Ascotaiwania palmicola* K.D. Hyde

##### Notes

*Ascotaiwania palmicola* was originally described from a palm rachis collected in Ecuador. This is the first record from Australia and from submerged wood.

#### HYPHOMYCETES

##### *Dictyochaeta subfuscospora* Kuthub. & Nawawi (Fig. 1)

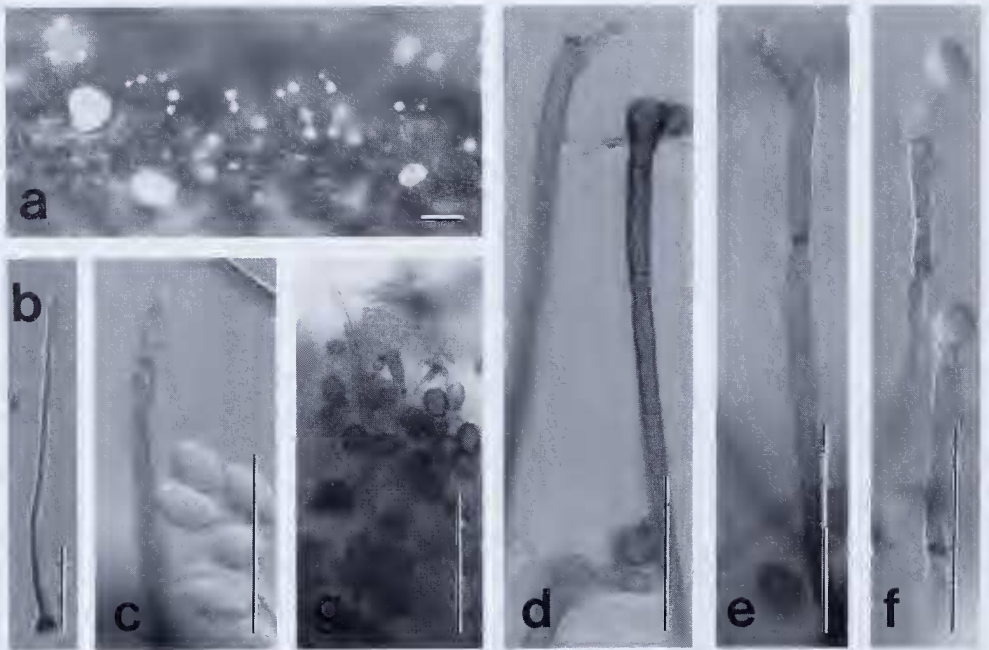


Fig. 1. *Dictyochaeta subfuscospora*: a representative portion of colonies on submerged wood; b conidiophore; c–f apical portion of conidiophores showing percurrent proliferations, phialides with collarettes, and developing conidia; g mature conidia that have become pigmented. Scales: a 200 µm, b–g 50 µm.

### Notes

*Dictyochaeta subfuscospora* was originally described from submerged decaying branches of an unknown angiosperm from Malaysia (Kuthubutheen and Nawawi 1991). This is the first record from Australia, also occurring on submerged wood. This collection of *D. subfuscospora* has pigmented, percurrently and sympodially proliferating, polyphialidic conidiophores with flared collarettes. The shorter, sympodially proliferating, monopialidic to polyphialidic, pigmented conidiophores found close to the substratum by Kuthubutheen and Nawawi (1991) were not seen in our collection. The conidia are ovate, non-septate, non-setulate, initially hyaline to subhyaline, later becoming pale brown,  $17\text{--}22 \times 6\text{--}8.5 \mu\text{m}$ , and form in slimy masses.

***Didymostilbe australiensis* Goh & K.D. Hyde, sp. nov.**

Conidiomata synnematosae, solitariae, subulato-capitatae, non-ramosae, determinatae, cremeae,  $250\text{--}500 \mu\text{m}$  altae, ad basim  $30\text{--}50 \mu\text{m}$  latae, apicem versus attenuatae usque  $15\text{--}50 \mu\text{m}$  latae. Hyphae stipitis ad basim intricatae, superne parallelis, septatae, laeves, simpliciae, ca.  $1 \mu\text{m}$  latae. Conidiophora non-ramosa, cellulace conidiogenae  $13\text{--}25 \times 1.5\text{--}2 \mu\text{m}$ , phialidicae, anguste cylindricae, apicem versus attenuatae, hyalinae, laeves. Conidiorum massa hemisphaerica vel subglobosa, mucoidea, terminalia, crema vel albolutescens. Conidia enteroblastica, 0–1-septata, interdum ad septa leniter constricta, cylindrica vel leniter clavata, apicem late rotundata, ad basim subtruncata vel obconico truncata, crassitunicata, laevia, hyalina,  $(8\text{--}9)\text{--}13\text{--}(15) \times (2.5\text{--})3\text{--}4 \mu\text{m}$ .

*Type:* Queensland, Cape Tribulation, Mt Lewis, on decaying wood submerged in a stream, T.M. and K.D. Hyde ML 28, vi.1995 (holotype BRIP).

Conidiomata synnematosus, solitary, subulate-capitate, unbranched, determinate, creamy white,  $250\text{--}500 \mu\text{m}$  tall,  $30\text{--}50 \mu\text{m}$  wide at the base, tapered to  $15\text{--}50 \mu\text{m}$  wide near the apex, conidiogenous head  $40\text{--}150 \mu\text{m}$  wide. *Hyphae of stipe* interweaving at base, parallel throughout stipe, septate, smooth, simple, ca.  $1 \mu\text{m}$  wide. *Conidiophore* unbranched, conidiogenous cells  $13\text{--}25 \times 1.5\text{--}2 \mu\text{m}$ , phialidic, narrowly cylindrical, tapering at the apex, hyaline, smooth. *Conidial mass* hemispherical to subglobose, mucoid, terminal, creamy white to pale yellowish. *Conidia* enteroblastic, 0–1-septate, sometimes slightly constricted at the septum, cylindrical to slightly clavate, broadly rounded at the apex, subtruncate to obconically truncate at the base, thick-walled, smooth, hyaline,  $(8\text{--}9)\text{--}13\text{--}(15) \mu\text{m}$  long,  $(2.5\text{--})3\text{--}4 \mu\text{m}$  in diameter. (Figs 2, 3)

### Notes

This differs from other *Didymostilbe* species (*sensu* Seifert 1985) in its conidial shape and size. In other species the conidia are larger ( $14 \mu\text{m}$  or more in length,  $4 \mu\text{m}$  or more in width) and are mostly ellipsoidal to fusiform in shape.

***Exserticlava vasiformis* (Matsush.) S. Hughes (Fig. 4)**

### Notes

*Exserticlava vasiformis* was originally isolated from wood in Japan by Matsushima (1975) (as *Cordana vasiformis* Matsush.). This species produces solitary, erect, thick-walled, dark conidiophores, each with a terminal funnel-shaped conidiogenous apex, which gives rise to 10–15 distoseptate conidia. The hyaline inner wall of the conidiogenous cell usually expands to  $20 \mu\text{m}$  wide and finally grows upwards as a hyaline, thick-walled, septate, subulate structure, up to  $120 \mu\text{m}$  long. This characteristic extension of the conidiophore is a readily identifiable feature. *Exserticlava* species have also been reported from New Zealand (Hughes 1978), North America (Crane and



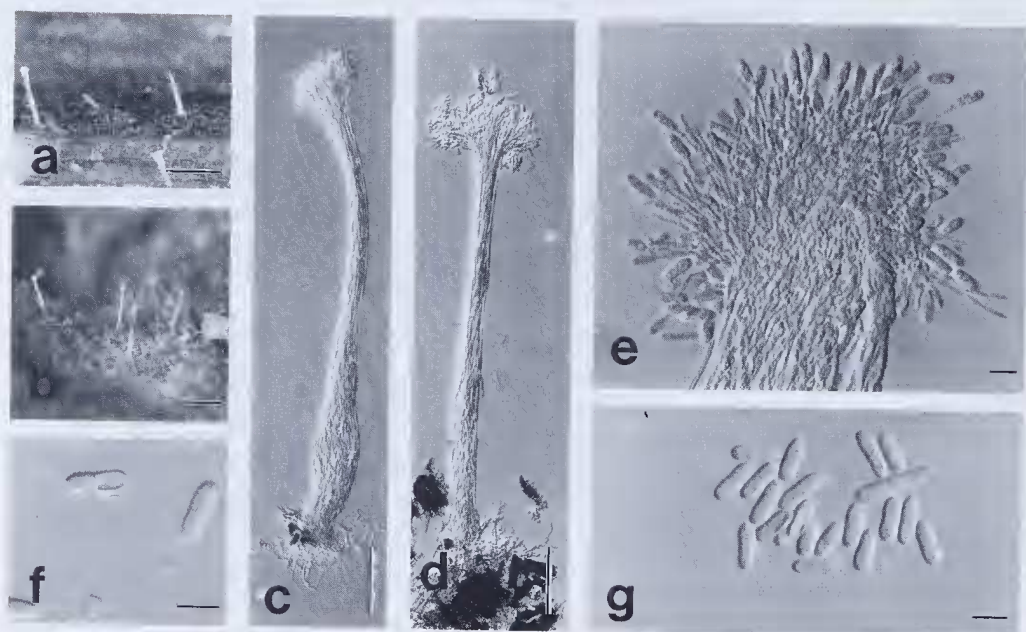


Fig. 2. *Didymostilbe australiensis*: a–b synnemata on submerged wood; c–d synnemata; e close-up of conidiogenous head of a synnema; f–g conidia. Scales: a–b 500  $\mu\text{m}$ , c–d 100  $\mu\text{m}$ , e–g 10  $\mu\text{m}$ .

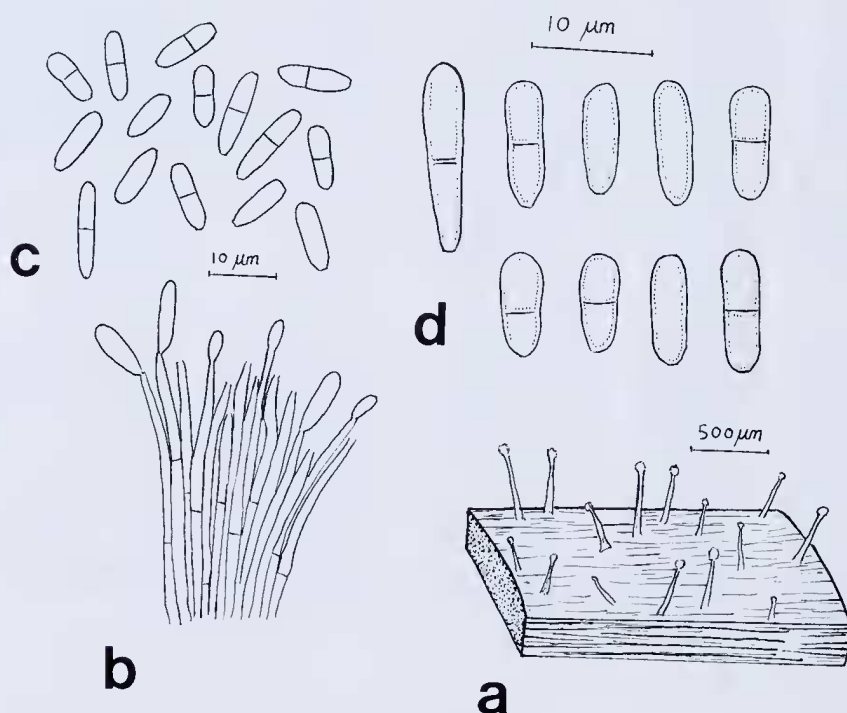


Fig. 3. *Didymostilbe australiensis*, diagrammatic representation: a synnemata on submerged wood; b phialides and developing conidia; c conidia; d close-up of conidia showing thick walls.

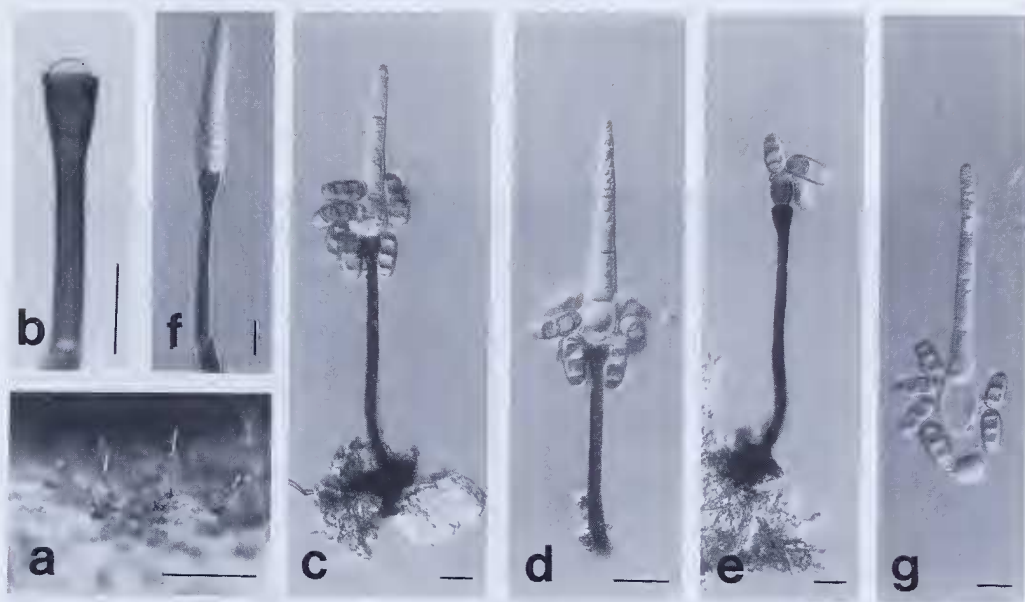


Fig. 4. *Exserticlava vasiformis*: a representative portion of colonies on submerged wood; b–e conidiophores and conidia (note the subulate, hyaline, multiseptate extension of the conidiophores); f apical portion of a conidiophore showing funnel-shaped conidiogenous cell; g subulate, septate, and hyaline appendage of the conidiophore and conidia. Scales: a 500  $\mu$ m, b–g 20  $\mu$ m.

Schoknecht 1982), Ethiopia (Bhat and Sutton 1985), Kenya (Kirk 1985), India (Rao and de Hoog 1986) and Malaysia (Kuthubutheen and Nawawi 1994). This is the first record from Australia.

#### *Helicomycetes roseus* Link (Figs 5, 6)

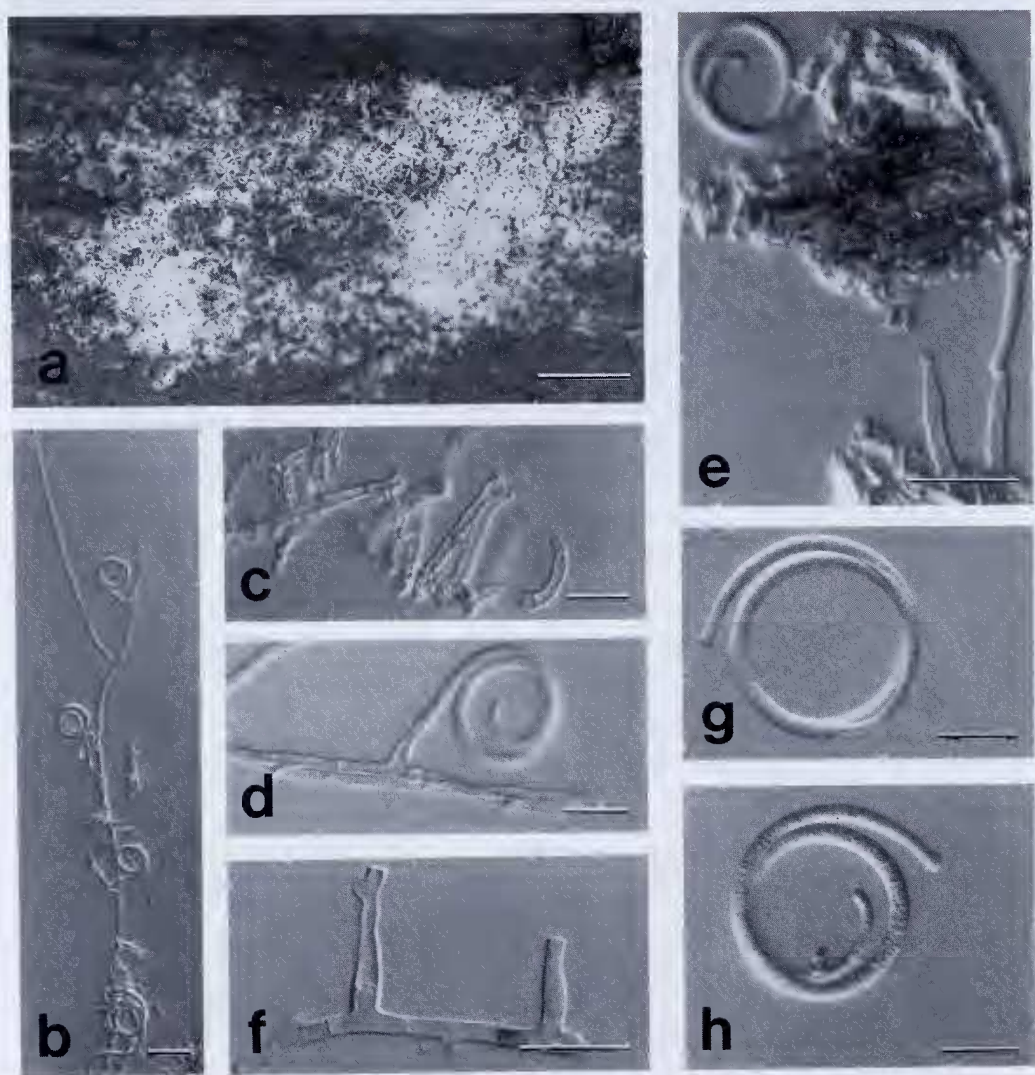
##### Notes

This species is characterised by the formation of effuse, thin, flocculose, white to pinkish colonies on natural substrata. The conidiophores are short, hyaline to very pale brown, and arise as short lateral branches of the repent mycelium. The conidiogenous cells are mono- or sympodially polyblastic, developing as denticles on the repent hyphae or as the terminal cells of the conidiophores. The conidia are hyaline and have a basal cell which is obliquely flattened, slightly swollen and attached eccentrically to the conidiogenous denticles. It is commonly found on dead wood, palm litter and other decaying vegetation. This species is widespread and has been reported from many countries (Goos 1985). However, this is the first record from Australia.

#### *Monotosporella setosa* var. *macrospora* S. Hughes (Figs 7, 8)

##### Notes

This species is characterised by having 2-septate, obovoid to obpyriform, versicoloured conidia. The terminal cell is large, black, and the lower two cells short, brown to dark brown, to almost black. It was originally reported from New Zealand (Hughes 1978) and this is the first record of its occurrence in Australia.



**Fig. 5.** *Helicomyces roseus*: a colonies on submerged wood; b–e conidiophores arising from superficial procumbent hyphae and developing conidia; f close-up of conidiophores; g–h conidia. Scales: a 500  $\mu\text{m}$ , b–h 20  $\mu\text{m}$ .



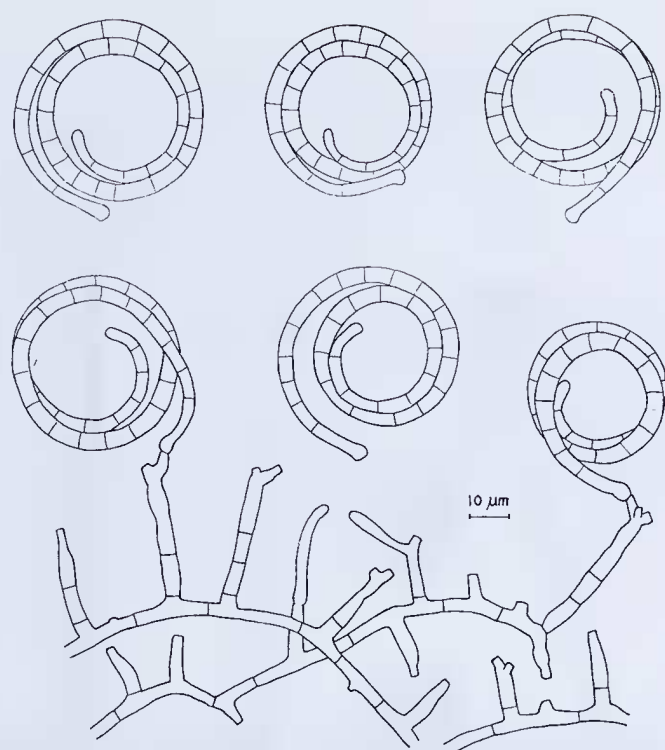


Fig. 6. *Helicomyces roseus*, diagrammatic representation of conidiophores arising from hyphae and conidia.



Fig. 7. *Monotosporella setosa* var. *macrospora*: a representative portion of colonies on submerged wood; b conidiophore; c basal portion of conidiophores showing pigmented, branched, septate hyphae immersed in substratum; d–h apical portion of conidiophores and developing conidia; i–j conidia. Scale: a = 200 μm, b = 20 μm, c–j = 10 μm.

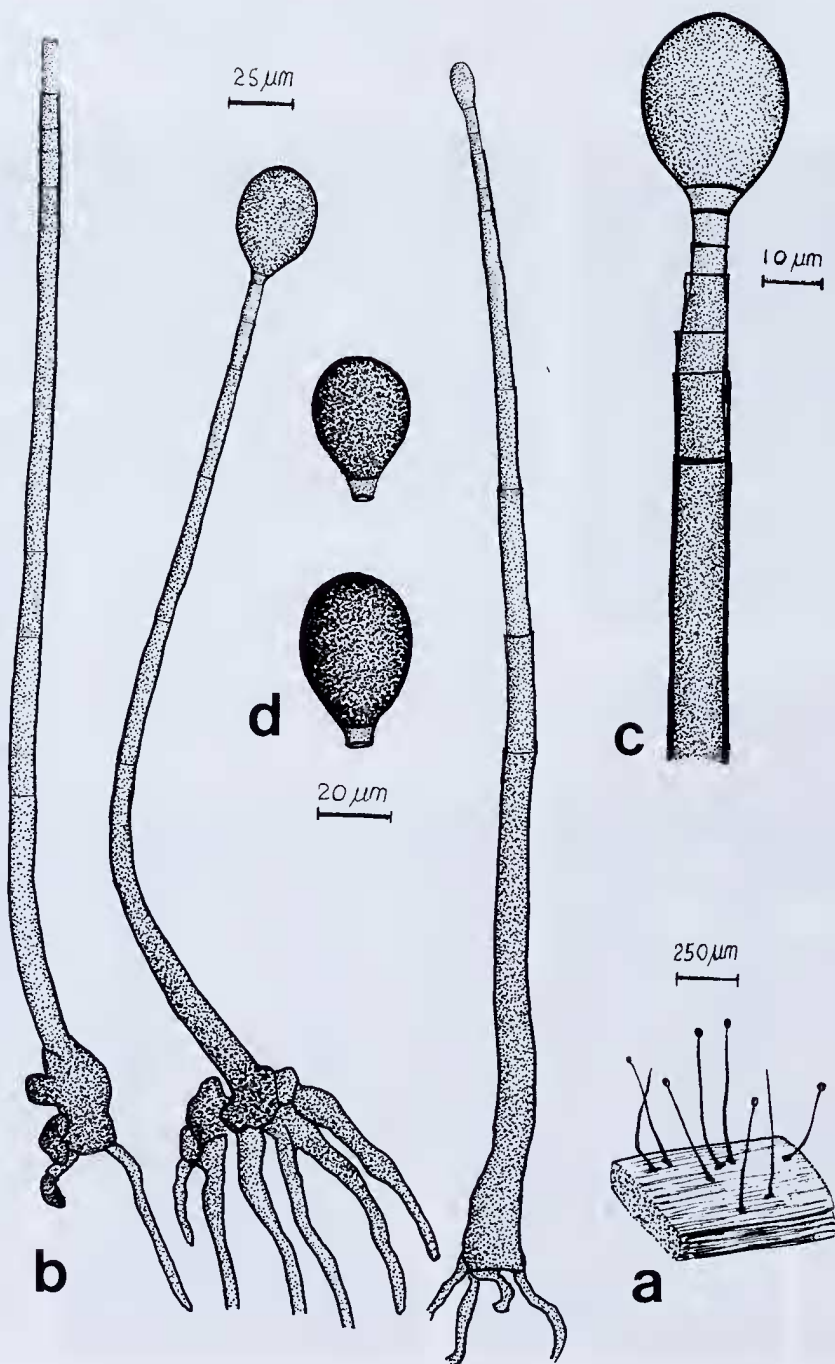


Fig. 8. *Monotosporella setosa* var. *macrospora*, diagrammatic representation: **a** representative portion of colonies on submerged wood; **b** conidiophores with percurrent proliferation and developing conidia; **c** apical portion of conidiophore showing percurrent proliferation and developing conidia; **d** conidia.

### Notes

This differs from other *Didymostilbe* species (*sensu* Seifert 1985) in its conidial shape and size. In other species the conidia are larger (14  $\mu\text{m}$  or more in length, 4  $\mu\text{m}$  or more in width) and are mostly ellipsoidal to fusiform in shape.

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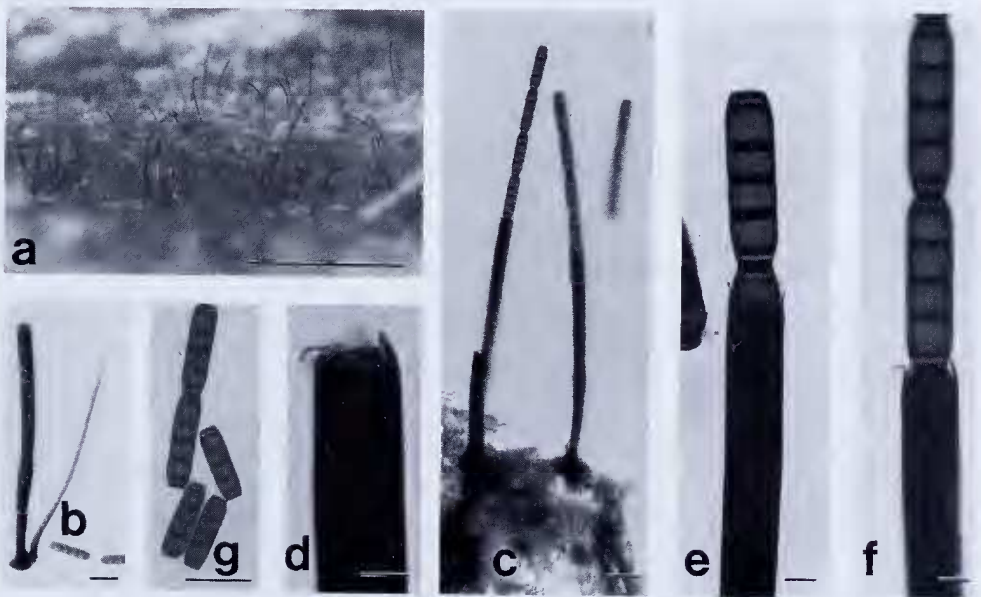


Fig. 9. *Sporoschisma saccardoi*: a representative portion of colonies on submerged wood; b a conidiophore with a basal capitate seta; c conidiophores producing chains of conidia from phialides; d close up of the apical portion of a phialide showing the frayed opening; e–f upper portion of phialides showing endogenous conidial productions; g conidia. Scales: a 500  $\mu\text{m}$ , b–c, g 40  $\mu\text{m}$ , d–f 10  $\mu\text{m}$ .

*Helicomyces roseus* (6%), *Jahnula bipolaris* (6%), *Massarina bipolaris* (5%), *Clohiesia corticola* (4%) and *Savoryella lignicola* (4%). There were 22 species recorded on one occasion each. The number of fungi identified on each sample is low, with an average of 0.9 species per sample. The fungi occurring on these wood samples were characteristic aquatic species and not indicative of aerial contamination.

There are no similar published results for comparison in the tropics, although somewhat comparable studies have been conducted in North America and United Kingdom. Shearer and Webster (1991) have listed the frequency of hyphomycetes occurring on submerged twigs in the river Teign in Devon, United Kingdom. They identified 39 species and found 0.4–1.57 species per twig (H' diversity). The numbers of fungi found per sample in this study, falls in the middle of this range, but caution is needed in comparisons, as the methods used in this study differ from those of Shearer and Webster (1991). Shearer and Von Bodman (1983) also investigated the frequency of occurrence of ascomycetes on packs of baited twigs in Jordan Creek in east central Illinois, United States of America. Thirty three ascomycetes were collected, although many were new and identified to genus only. The frequencies of occurrence ranged from 1–20% depending on the length of submergence and wood species. Only one species (*Savoryella lignicola*) occurred in the stream on Mt Lewis and Jordan Creek. This is an indication of the high diversity of fungi yet to be located on submerged wood in tropical rivers.

The results presented here go some way towards determining the assemblage of fungi occurring on submerged wood in the tropics. Direct incubation has been shown to yield more ascomycetes and less aquatic hyphomycetes when compared to bubble chamber incubation (Shearer and Webster 1991) and therefore our techniques may exclude certain Ingoldian fungi.

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